made in two halves, a groove of a zigzag form being cast in each half, so that when the two are screwed together a continuous channel is maintained through the bearings for a current of cold water to pass during the whole time the machine is at work.

The advantages suggested by these arrangements are their extreme simplicity, the few number of parts, only one armature and one wire being used.

This principle of the alternate current being utilized is also applicable to machines constructed on the multiple armature principle; and the economy thereby resulting would prove of great advantage, as the power of the machine could be varied by throwing into the electromagnets either every other current, or every fourth, sixth, or eighth current, according to the strength required in the machine, the whole of the other currents being utilized for electric light or otherwise.

II. "Note on the Anatomy of the Umbilical Cord." By Lawson Tait, F.R.C.S. Communicated by W. S. Savory, F.R.S. Received April 28, 1875.

(Abstract.)

I. Its external form and method of growth.
II. Its covering.
III. Its substance.
IV. Its vessels.
V. Its relations to the fœtus and placenta.
VI. Its nutrition.

I. The spiral form of the cord has received many explanations; but hitherto none has seemed satisfactory, nor sufficient to explain all the facts. The cause of the spiral form has generally been regarded as existing in the arteries; but experiment shows that the vein is the chief factor.

The considerations drawn from the comparative and teratological anatomy of the cord point to the conclusion that its twist must depend upon some mechanism at the fœtal insertion.

Such mechanism is found in a peculiar camb-like growth of the dermal ring of the umbilicus, and in an arrangement of capillaries upon which the nutrition of the cord depends, that nutrition being supplied over the venous surface of the cord in about the proportion of three to two on the arterial surface. This unequal nutrition would seem necessarily to result in a spiral.

II. When the surface of the cord is treated with litmus or hæmatoxylin, the epithelial covering is found to consist of a single layer of irregularly polygonal cells, regularly nucleated. The fibrillar matrix on which they lie is evidently only a slightly condensed arrangement of the canalicular tissue. Silver-staining shows that these cells have a peculiar irregularity in size and arrangement.

Well-marked stomata, both spuria and vera, are to be seen on the surface, the latter unquestionably forming orifices of entrance into the vast system of canals of which the proper system of the cord is composed.

The epithelium varies somewhat in its arrangements near the placenta and near the fœtus.

In the former position the cells are smaller, more irregularly jointed, and apparently somewhat more elongated in the direction of the long axis of the cord than they are near the fœtus.

The whole appearance of the cells gives the impression that the covering is older here; and in the canals and in the stomata are to be seen rows of minute refracting globules, visible only under very high powers, the nature of which I have been unable to make out, as they appear only after deep silver-staining.

III. The alveolated canalicular tissue of the cord is divided throughout its entire length into three columns, the divisions between which are not visible to the naked eye, but become very perceptible when one of the columns is injected by Recklinghausen's method.

When the canals are empty they present the appearance of fibrous tissue by the collapse of their walls, and when partially distended they look like stellate cells. This has led to the erroneous description of a fibrous matrix in which occur stellate cells. In the lacunar spaces of the canals the oval nuclei are imbedded.

These nuclei do not alter their shapes or positions.

In injecting this system of canals, the fluid passes more readily in the direction from the fœtus to the placenta than in the reverse way.

During the process minute streams of the injection may be seen flowing from the surface of the cord; and these are not due to rents.

Transverse and longitudinal sections of the injected columns show that the canals are stellate in every plane.

In the alveoli between the canals the wandering cells are found. Silver-staining shows that these canals are walled. The nuclei are not fusiform, for when magnified 1000 diameters they are seen to be oval and provided with a very small nucleolus. The statement that they send processes into the branches of the canals is due to an optical illusion, dispelled by the use of high-power immersion lenses.

The round cells which occur in the alveoli have very large nuclei, quite disproportionate to the surrounding protoplasm.

They are not constant. In some cords, especially those removed from large children, they are found very scantily, whilst on the cord of a small eight-months' child they were found to be extremely abundant.

They are also often more numerous in some parts of the cord than in others, and in one district of the cord than in another.

They are most abundant near the umbilicus and near the capillaries. They may be seen moving on the warm stage and exhibiting amœboid movements after having taken up litmus colour.

I have not been able to discover any nerve-fibres in the cord.

The canalicular tissue may be demonstrated to end in three cones, one for each column of the cord, the apices of which are just within the dermal ring. The injection will not pass through the tendinous ring; nor have I succeeded in making it enter the capillaries of the cord from the canalicular tissue.

When the injection of the capillary plexus running from the dermal ring has been successfully accomplished (and this is, for many reasons, a difficult thing to do), there will be found a peculiar vascular arrangement in the centre of the cord, lying in the firm nucleated tissue which forms the omphalic ring. The basis of this arrangement is a peculiar sacculated sinus, a mere excavation in the fibrous tissue, as it is doubtful if it has any definite wall. It seems to have a spiral arrangement, for in one section it appears and disappears as only a screw could.

It extends from the omphalic ring at least forty-five millims. up into the true substance of the cord, giving off at short intervals thick trunks which rapidly break up into capillaries.

These capillaries do not form loops, but enter directly into the canalicular tissue; and it is possible to inject a large extent of all three districts of the substance of the cord by passing the injection through the fœtus. This sinus seems to originate from the small arteries of the anterior abdominal wall, which enter with the vein.

There seems to be a close analogy between this arrangement and that of the Haversian system in bones; indeed the actual resemblance sometimes seen is very close.

IV. The proper tissue of the vessels is made up of the ordinary fusiform fibre-cells, with their characteristic rod-shaped oval nuclei. The outer layers seem to have wider limits of contraction than the inner—these latter being thrown into rugose folds on the contraction of the arteries, resembling the appearance of the contracted urethra or œsophagus. One reason of this exceptional range of contraction is, that the fibres of the muscular tissue are arranged in bundles having a double spiral direction. The contraction of the fibres seems to be governed by the blood-current, as they contract as soon as the blood in them becomes arterial by the establishment of respiration; and they may be seen again to relax and pulsate if the blood becomes again venous by the temporary arrest of respiration.

This appears to be aided by the absence of an endothelial lining to the arteries, which my observations seem to establish.

The closure of the vessels is effected immediately by clot, and subsequently by the agency of the round migratory cells.

These wandering cells seem also to share in the subsequent processes of inflammatory ulceration and necrosis of the stump of the cord, and in the removal of the coats of the remaining vessels.

V. The relation of the cord to the fœtus has already been described.

The limitation of the canalicular tissue of the cord, at its placental attachment, is quite as abrupt.

The injection-fluid cannot be made to pass from the substance of the cord into the placenta, for it is arrested by a firm membrane derived from the chorion, which the vessels of the cord penetrate, and between two layers of which they lie. There is absolutely no connexion between the nutritive system of the cord and that of the placenta.

VI. The chief factor in the nutrition of the cord is the arrangement of capillaries entering it from the fœtus. From the facts observed by me in cases of extra-uterine gestation, it is likely, however, that the stomata of the epithelial surfaces of the cord play an important part in its nutrition.

The liquor amnii contains substances which are very suggestive that the fluid is used for purposes of nutrition, and perhaps for the nutrition of the cord. In recent cases of extra-uterine fœtation, before the liquor amnii becomes absorbed, the cord remains fresh and plump. After the fluid has been absorbed the cord becomes shrivelled; but it still retains its structural characters, minus the wandering cells. It may be, therefore, that the canalicular nuclei are able to keep the cord in repair, as it were, by the matters absorbed from the liquor amnii, until that fluid disappears—very much as ivy continues to live after its connexion with its root has been severed. Indeed the analogy between the umbilical cord and vegetable tissue is, as I hope to be able to show further, a very close one.

III. "First Report of the Naturalist accompanying the Transit-of-Venus Expedition to Kerguelen's Island in 1874." (Conclusion.) By the Rev. A. E. Eaton. Communicated by the President. Received May 10, 1875.

In January 1875, shortly after the departure of the American Expedition from Royal Sound, an opportunity occurred of visiting another part of Kerguelen's Island. To relieve the ennui of his officers and men, who by that time were thoroughly tired of being detained without any definite occupation in an uninhabited island, Captain Fairfax ordered the 'Volage' to leave Observatory Bay, and proceeded to Swain's Bay, where he remained three weeks. During this period he entertained me as his guest, took me to the best localities in the bay for collecting, and rendered me every assistance that lay in his power. The Royal Society is therefore indebted to Captain Fairfax for a fine series of Algæ from Swain's Bay, comprising many species not found in Observatory Bay, and some that were not known to be indigenous to the island. Most of these are described in the 'Flora Antarctica' as Falkland-Islands species. Captain Fairfax at the same time enabled me to secure the skeleton of a *Globiocephalus*, which was found dead in shallow water by Mr. Forrest (Mids.). Most of the epidermis had been removed by small